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Digital media impacts multiple aspects of self representation: An investigation of
flow, agency, presence, character identification and time perception

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Abstract

Research in cognitive science is rapidly increasing our understanding of the cognitive mechanisms that give rise to our sense of being a unified conscious self, and that allow us to interact in purposeful ways with the external environment. Laboratory research has shown that experimental manipulations involving computer based tasks can alter aspects of our self representation. In the current study we investigated how complex digital media, experienced in real-world settings, impacts aspects of self processing. Specifically, we investigated experiences of self representation associated with active media such as video games and passive media, such as film or television, in naturalistic settings. 222 participants completed measures of flow, sense of agency, presence, character identification and time perception, reporting on their engagement with both active and passive media. Results showed reduced agentive involuntariness, but increased flow, presence, character identification, and time perception for active compared to passive media. Trait conscientiousness, neuroticism and openness each were associated with aspects of altered self representation during media engagement. Absorption was associated with increased flow, presence and character identification. This study presents nuanced differences in the way that active and passive media impact self processing, and highlights features that may enhance engagement with digital media.

Keywords: media, self representation, flow, agency, presence, character identification, time perception, personality, absorption.

Digital media impacts multiple aspects of self representation: An investigation of flow, agency, presence, character identification and time perception

In recent years, considerable attention has been paid in cognitive science research to understanding the mechanisms underlying self representation. That is, to identifying and measuring those components of conscious experience that give rise to our sense of being a unified self and that allow us to interact in purposeful, responsive ways with the external environment (Blanke, Slater, & Serino, 2015; Haggard, 2017; Tsakiris, 2016). Much of this research has focused on exploring the operation of low-level multisensory perceptual or cognitive cues, and mapping out how these cues influence the way individuals make sense of the world (Blanke, 2012). For example, this work has identified how cues such as visual form plausibility influence the degree to which ambiguous stimuli are recognised as either self-caused or externally generated (Pritchard, Zopf, Polito, Kaplan, & Williams, 2016). This research has been largely restricted to highly manipulated experimental paradigms that use controlled stimuli to influence alterations in self representation. Less attention has been paid to systematically exploring how complex and realistic digital environments influence and interact with our sense of self. In this study we explore 1) how multiple components of self representation are influenced by different types of real-world computer and media interactions; and 2) how individual difference characteristics shape the quality of these interactions.

Television, movies and videogames are ubiquitous forms of entertainment. They share a number of common characteristics, including a central visual aspect. The forms cross-pollinate, for example with games spawning movies (e.g., *Tomb Raider*) and television shows spawning games (e.g., *The Walking Dead*). Yet there are significant differences between them. Not all games boast realistic, high-quality graphics and even those that do are still recognizably a virtual construct. More significantly movies and television do not offer their audience the interactive opportunities that lie at the core of games. Understanding how these

different kinds of media lead to different experiences of self representation has important implications for media producers, designers of computer technologies, and also for media consumers. The relationship between audience and media can be conceptualized in many ways. At a broad level it seems obvious to observe that active media such as computer games involve a higher level of engagement than passive media, such as movies or TV. But there are multiple, interrelated cognitive and psychological variables related to self representation that may be involved in processing media of different kinds, and these may function in unintuitive ways.

A viewer may become deeply engrossed in media content to the point that their experience takes on a flow-like quality of automaticity (Jung, Perez-Mira, & Wiley-Patton, 2009); they may regard themselves as having a level of agency over events depicted in media (J. H. Murray, 2017); they may conceive of themselves as actually present in the fictional/virtual world (Sheridan, 1992); they may explicitly identify with characters in the viewed media (Soutter & Hitchens, 2016); and they may experience distortions in time perception (Rau, Peng, & Yang, 2006). These five aspects of self representation - experiences of flow, alterations to the sense of agency, feelings of presence, character identification, and time distortions – provide a window into the ways that different kinds of media can influence and interact with our self-concept.

1.1 Flow

Flow refers to an experience of intense subjective involvement in an activity or environment. A defining feature of flow is focused attention on the target activity to the exclusion of one's surrounds. Flow is often described as occurring during moments of intense performance by elite sportspeople or artists (Swann, Keegan, Piggott, & Crust, 2012), but flow can also be experienced as part of more typical daily events by non-experts (Ullén et al., 2012). Csikszentmihalyi (1991) identified eight characteristics of flow: clear goals; high degree of concentration; a loss of the feeling of self consciousness; distorted sense of time;

direct and immediate feedback; balance between ability level and challenge; sense of personal control; and a sense of intrinsic reward. Each of these characteristics has been identified in theoretical analyses of media engagement (Chen, 2007). Flow is almost exclusively discussed with reference to performing actions and, consequently, media researchers have mainly focused on exploring flow in active contexts of user engagement with media. Most attention has been directed at computer-human interactions (Kaur, Dhir, Chen, & Rajala, 2016; Webster, Trevino, & Ryan, 1993), and in particular video games (Weibel, Wissmath, Habegger, Steiner & Groner, 2008; Keller, Ringelhan & Blomann, 2011). This work has explored, for example, flow experiences associated with differing types of computer games (Takatalo, Häkkinen, Kaistinen, & Nyman, 2010), the effects on flow of playing games with human compared to computer controlled teammates (Kaye & Bryce, 2014; Weibel, Wissmath, Habegger, Steiner, & Groner, 2008), and the role of flow in accounting for perseverance in games (Hsu & Lu, 2004). Although there is evidence to suggest that flow can also be experienced in passive imaginative experiences such as reading (Mcquillan & Conde, 1996), there has been little attention paid to experiences of flow associated with passive media such as engagement with films or television.

Several researchers have developed scales specifically aimed at quantifying flow associated with video games (Fox & Brockmyer, 2013; O'Brien & Toms, 2010), but the most commonly used measure in flow research on video games (and more generally), is the Dispositional Flow Scale (Jackson, Martin, & Eklund, 2008; Wang, Liu, & Khoo, 2009). Although there have been mixed reports of the precision of this measure in the context of video games (Procci, Singer, Levy, & Bowers, 2012; Wang et al., 2009), we selected this tool in the current study as it appeared the most likely to provide meaningful and psychometrically sound comparisons across both active and passive media.

1.2 Sense of Agency

Sense of Agency refers to the subjective feeling of causing events to occur in the world (Moore, 2016). The concept of agency occurs in the literature of a range of disciplines, including psychology, social theory, media theory and behavioural studies, and is understood in each field in subtly different ways (Polito, Barnier, & Woody, 2013). Experimental psychologists and philosophers often describe the phenomenology of agency as comprising two components, an implicit feeling of involuntariness and a more reflective judgment of effort (Gallagher, 2012; Synofzik, Vosgerau, & Newen, 2008).

Within the domain of media research, investigation of the cognitive mechanisms underlying agency alteration has been less emphasised, but there has been considerable attention paid to how different elements of human-computer interaction relate to a sense of agency. In particular researchers such as Murray and Murray (2017), Stern (2008) and Anstey (2005) have discussed how the interactive nature of computer games captures and exaggerates a player's feeling of agency for their overall environment. In other work, Hammer (2007) proposed a theoretical account of how four different aspects of agentive experience (textual, narrative, psychological, and cultural agency) can be influenced by design choices in computer games.

Typically, empirical studies of media manipulate agency to see explore how conditions with varying levels of active involvement influence some other measure. For example Madsen (2016) showed that participants exhibited greater levels of fear response when playing compared to watching a horror themed computer game. Similarly, Lin (2013) showed increased physiological responses when participants played rather than watched a violent video game. To date, there has been little empirical investigation of how engagement with different types of media may itself influence individuals' sense of agency.

1.3 Presence

Presence is the subjective experience of feeling situated in a mediated environment - of 'being there'. The concept of presence originated from the work of Minsky (1980) and Johnsen and Corliss (1971). Minsky examined how a human operator can feel present at a remote location due to the perceptual feedback received from the technology employed. Similarly, Johnson and Corliss, recommended that technology be designed so that it will "help the operator project his presence" (p. 37) into a workspace in which they are not physically located. Whereas both flow and sense of agency can be altered in many different contexts, the concept of presence is almost exclusively linked to human interaction with technology.

Researchers have proposed different conceptualisations of the structure underlying a sense of presence. IJsselsteijn, de Ridder, Freeman and Avons (2000) described two broad aspects: spatial presence, which refers to the subjective experience of existing within a virtual environment; and social presence, which refers to the feeling of being together with another agent who is geographically separate. In a more detailed conceptualisation, Lessiter, Freeman, Keogh, & Davidoff (2001) distinguished between spatial involvement, engagement with the environment, believability of content in the virtual world, and physiological impacts (see 2.2.4 for more details).

There is a considerable body of research investigating the role of presence in media engagement (Kwan Min Lee, 2004; Lombard & Ditton, 1997). One stream of research has focused on exploring how different media technologies influence presence. This has shown that more immersive media technologies are associated with greater levels of felt presence. Increasing the size of a viewing screen, displaying stereoscopic rather than monoscopic content, and adding movement have all been found to increase subjective presence (IJsselsteijn, Ridder, Freeman, Avons, & Bouwhuis, 2001). Similarly, when the same media content is experienced using a head mounted display, this is rated as involving greater presence than a semi-immersive video wall, which in turn is rated as involving greater

presence than a PC monitor (Baños et al., 2004). A second stream of research has focused on affective and social aspects of media engagement. For example, Riva et al. (2007) showed that media content rated as highly emotional was more likely to influence presence than low emotion content. Ravaja, Saari, Turpeinen and Laarni (2006) have shown that the social identity of other characters in the virtual world can profoundly influence presence. They found that playing a computer game with a human opponent led to more presence than playing with a computer opponent; and that playing with a known friend led to more presence than playing with a stranger. To date however, empirical research on presence has mainly involved media content chosen by experimenters, and the construct has usually been investigated in laboratory settings. Less is known about everyday experience of presence in natural settings.

1.4 Character Identification

Character identification has been studied from multiple theoretical and empirical viewpoints. There is no single, accepted, understanding of the concept and no standardised measure of character identification. Instead, several frameworks have been suggested. These can be briefly summarised as empathy or sympathy for a character (Oatley, 1999); a desire to be like or act like a character (Hoffner & Buchanan, 2005); and a perception of existing similarity to a character (Hefner, Klimmt, & Vorderer, 2007).

Oatley (1999) conceptualised character identification as an emotional, empathic experience whereby a viewer becomes the protagonist through taking on the protagonist's goals and plans, and experiencing emotions depending upon their success or failure. Smahel et al (2008) described this process in terms of attachment theory. They investigated this empirically by measuring perceived similarity between players and characters in a massive multiplayer online role playing game. Participants rated the similarity between player and character, and also whether characters had greater skills than, or skills that compensated for,

those of the player. They found that positive character identification was closely related to compulsion to play the game.

Hoffner and Buchanan (2005), following on from earlier work on celebrity attachment, proposed conceptualising character identification in terms of ‘wishful identification’. They described this as a desire or attempt to become like another person. Hoffner and Buchanan examined identification with characters from television programs, by asking participants to rate their desire to be like, or act like, their favourite characters. A similar theoretical approach was taken by van Reijmersdal, Jansz, Peters and van Noort (2013), who looked at character identification amongst young female gamers. They found that character identification was a major motivation for video game engagement in this population.

Klimmt, Hefner, & Vorderer (2009), conceptualised character identification as a shift in self-perception. For these authors there is a distinct difference in identification between games and non-interactive media. For the latter, the observer perceives a social distinction between themselves and the character. In the former the players cease to perceive themselves as distinct from the character, instead experiencing a merging of their self with the character. Hefner et al. (2007) measured perceptual distance for participants playing versus watching a video game using questions such as “I had almost the feeling of being the game character” and “I have forgotten myself during the game.” They found that character identification was higher for those playing than for those watching.

1.5 Time Perception

A final aspect of self representation that can be influenced by media engagement is time perception. It is a common intuition that enjoyable or engrossing activities are associated with reduction in subjective time duration (Droit-Volet & Meck, 2007). Media engagement is, for most people, a leisure activity and, anecdotally, seems to involve such time distortions. It is not clear however, how different types of media engagement might influence the perception of time. Theoretically, changes in time perception may be a secondary effect of alteration to

other aspects of self-representation. For example, time distortion is explicitly defined as a component of flow (Csikzentmihaly, 1991). Similarly agency changes have been closely linked with alterations in subjective time perception (Moore & Obhi, 2012), and distortion of time has been described as a characteristic of presence (Lessiter et al., 2001). These findings point toward time perception being a likely aspect of self-experience that may be influenced by media engagement. Given these overlaps, alterations in time perception may already be contributing to broader changes in self representation. Nevertheless, we have included a brief independent measure of time perception in the current study in order to explore how experiences of time vary in different types of media engagement.

1.6 Trait Influences

The work reviewed here shows different ways in which media engagement might influence self representation. Most of this research has investigated how properties of the technology or media content might influence self representation. Another important source of variation for understanding media's influence on self representation is individual difference characteristics of media consumers. Very little is known about how such human factors influence flow, sense of agency, character identification, or time perception in the context of media engagement. There has been some research into individual differences in experiences of presence (see Alsina-Jurnet & Gutiérrez-Maldonado, 2010 for an overview). These studies, however, have mixed findings. Laarni (2004) reported that extraversion is associated with increased presence, but Alsina-Jurnet and Gutiérrez-Maldonado (2010) reported that introversion is a predictor of increased presence for anxious participants. McCreery, Schrader, Krach and Boone (2013) have also claimed that agreeableness predicts presence. Looking beyond classic personality traits, several researchers have investigated *absorption* – a tendency toward intense imaginative involvement in events or objects. Although there are reports of a robust relationship between absorption and presence (Baños et al., 1999; Kober &

Neuper, 2013), not all studies have not identified this association (C. D. Murray, Fox, & Pettifer, 2007; Sas & O'Hare, 2003).

Research on character identification has also highlighted the importance of pre-existing traits. Soutter and Hitchens (2016) showed that openness was positively associated with character identification, and that extraversion was negatively associated with character identification. Conversely, McCreery, Krach, Schrader and Boone (2012) showed that players who were more agreeable in real life also played their character as more agreeable in a multiplayer role playing computer game.

A challenge of comparing findings across studies is the lack of standardised paradigms in this area of research. Investigators tend to develop idiosyncratic experimental tasks suited to their specific research question. This makes generalising about overall relationships between self representation and individual difference characteristics difficult.

1.7 Current Study

Past research has shown that flow, agency, presence, character identification, and time perception are all affected by media engagement. However most previous studies have focused only on active media, and there has been very little comparative work done on how individuals experience these concepts across different forms of media in ecologically valid settings. The first aim of the current study was to investigate alterations in self representation across both active (video games) and passive media (film and television). Our second aim was to explore the degree to which any differences in self representation between active and passive media were related to individual difference characteristics. In particular, we aimed to explore the influence of classic personality traits and absorption on media engagement with real-world content in naturalistic settings.

Participants were asked to report on their every day experiences of multiple forms of media. Participants completed standardised measures of self representation (tapping flow, sense of agency, presence, character identification and time perception) associated with their

media experience, and individual difference measures (personality traits and absorption). We had three broad hypotheses. First, we expected more pronounced self representation changes for active compared to passive media across each of our primary measures. That is, we expected greater distortions of flow, agency, presence, character identification, and time perception for video games compared to film or television. Second, we expected that the various components self representation assessed in this study would closely relate to one another. Specifically, we expected that measures of flow, agency, presence, character identification, and time perception would be associated, reflecting a core phenomenology of self representation that is effected by media engagement. Third, we expected that key trait variables that have been identified in previous research as predictors of altered self representation would have a general impact on participants' overall level of media engagement. Specifically, we expected that extraversion, openness, agreeableness and absorption would be associated with increased levels of alteration in self representation regardless of media type.

2. Method

2.1 Participants

350 participants completed the study online, however only 222 participants (142 males, 80 females) met the inclusion criteria of nominating both a specific video game and a specific movie or TV show that they engaged with for more than one hour per week. 61 (27.5%) participants were aged 18-25, 85 (38.3%) aged 26-35, 52 (23.4%) aged 36-45, 18 (8.1%) aged 46-55, and 6 (2.7%) aged over 55. 179 (80.6%) participants were from the USA, 38 (17.1%) participants were from Australia, and the remainder were from the United Kingdom, Norway, and the Philippines. 93 (41.9%) participants reported their highest education as high school, 106 (47.7%) had an undergraduate degree, and 23 (10.4%) had a postgraduate degree. Participants were recruited through posts on online gaming forums and entered into a prize draw for a \$50 Amazon voucher, or were recruited through Turkprime (Litman, Robinson, &

Abberbock, 2017) and compensated \$7.50 for participation. This research was approved by the Macquarie University Ethics Review Committee (Human Research).

2.2 Materials

This study involved a set of demographic questions, six measures of self representation, and two trait measures.

2.2.1 Demographic Questions. We constructed a set of questions recording participants' age range, gender, level of education, country of residence, and media preferences. To characterise individuals' engagement with media, participants were first asked to nominate a specific media title they enjoyed (either a video game or movie / TV show). For the nominated title, participants were then asked to report the genre and plot; the amount of time spent engaging with this media each week; and the social context of media engagement (alone, physically present with others, virtually connected with others).

Self representation measures were focused on experiences associated with specific media and were repeated so that participants provided reports both for engagement with a video game and engagement with a movie or TV show (see below). The self representation measures used were:

2.2.2 Short Dispositional Flow Scale (S-DFS; Jackson et al., 2008). The subjective sense of flow is a positive feeling of being optimally engaged and focused on a target experience. The S-DFS is a short form of the dispositional flow scale (Jackson & Eklund, 2002) that measures the tendency to experience flow in a given setting. Alternate forms of this scale exist that seem at first glance to be a better fit for a state focused assessment of flow (e.g., Flow State Scale, Short Flow State Scale), but those measures are designed for assessment of a target experience immediately after the experience has concluded. As participants in the current study retrospectively evaluated their typical media experiences, the

dispositional form of the scale was deemed more appropriate. The S-DFS consists of 9-items assessing the nine dimensions of flow identified by Csíkszentmihályi (1991): (1) a balance between the challenge of the task and skills of the individual, (2) a merging of action and awareness, i.e. one performs the activity almost “automatically”, (3) clear perceived goals, (4) unambiguous feedback, (5) focusing on the task at hand, (6) a sense of control of the activity, (7) a loss of self consciousness or a reduced awareness of self, (8) time transformation, i.e. sense of time becomes distorted, and (9) an autotelic, intrinsically rewarding experience, implying that the activity in itself is a reason for performing it instead of any external objectives. This short form is scored as a single factor.

2.2.3 The Sense of Agency Rating Scale (SOARS; Polito et al., 2013). The SOARS is a 10-item scale that measures subjective alterations to the sense of agency related to some specific experience. Participants were instructed to think of their media experience and to rate their level of agreement with a series of statements on a 7-point Likert scale from “strongly disagree” to “strongly agree”. The scale has two factors: (1) *involuntariness*, with items such as “I felt that my experiences and actions were not caused by me”, which represent a subjectively-experienced reduction in control over one’s own actions; and (2) *effortlessness*, with items such as “My experiences and actions occurred effortlessly”, which represent a subjectively-experienced increase in the ease and automaticity with which actions occur. Although the SOARS was originally developed for use in hypnosis (Költő & Polito, 2017; Polito, Barnier, & Connors, 2018), it has also been used in research on psychopathology (Polito, Langdon, & Barnier, 2015), and we used a modified, general form, which is applicable in any context (Pritchard et al., 2016).

2.2.4 Independent Television Commission Sense of Presence Inventory (ITC-SOPI Lessiter et al., 2001). The ITC-SOPI measures presence, the subjective feeling of being immersed in a media experience. Whereas most psychometric measures of presence

specifically target experiences of virtual reality, the ITC-SOPI taps experiences of presence associated with all forms of media. Participants rate their level of agreement with 44 items on a 5-point Likert scale. The scale has four factors: (1) spatial presence, with items such as “I had a sense of being in the scenes displayed”; (2) engagement, with items such as “my experience was intense”; (3) ecological validity, with items such as “the content seemed believable to me”; and (4) negative effects, with items such as “I felt disoriented”.

2.2.5 Presence Scale (Sanchez-Vives & Slater, 2005). We included an additional presence scale, comprised of three 7-point Likert items: (1) “To what extent did you have a sense of being in the virtual environment”, rated from “not at all” to “very much so”; (2) “To what extent were there times during the experience when the virtual environment became ‘reality’ for you, and you almost forgot about the ‘real world’ of the laboratory in which the whole experience was really taking place?”, rated from “never” to “almost all the time”; and (3) “When you think back to your experience, do you think of the virtual environment more as *images* that you saw, or more as *somewhere that you visited?*”, rated from “only images that I saw” to “somewhere that I visited”. These items were used as a general measure of the experience of presence (in contrast to the specific subdimensions of presence tapped by the ITC-SOPI).

2.2.6 Character Identification Questions. Participants were also asked a series of five questions about the main character portrayed in the target media. They rated 1) the degree to which the character acts similarly to them, 2) how similar the character looks to them, 3) how much they felt that they were the character, 4) the degree to which the character’s body becomes their own, and 5) how much they would like to become like the character. All questions were rated on a 7-point Likert scale. We calculated a *Character Identification* score, which was the mean of these five ratings.

2.2.7 Time Perception Questions. We included a measure of time perception, adapted from Wittmann and Lehnhoff (2005). This scale consisted of a single item asking participants to rate their subjective experience of time on a 5-point Likert scale from very slow (1) to very fast (5) in each media context. Specifically, participants were asked to rate their typical experience of time associated with video games (“how fast does time usually pass for you when playing video games?”), and their typical experience of time associated with movies or TV (“how fast does time usually pass for you when watching movies or TV”).

The trait measures were:

2.2.8 M5-50 Personality Questionnaire (Socha, Cooper, & McCord, 2010). The M5-50 is a personality measure based on the International Personality Item Pool (Goldberg et al., 2006). It consists of 10 items for each of the traits in the Five Factor Model of personality (Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism). Participants score each item on 5-point Likert scale, indicating how accurate each statement is as a self descriptor.

2.2.9 Tellegen Absorption Scale (TAS) Tellegen & Atkinson, 1974). The TAS measures a disposition towards subjective restructuring of the phenomenal self and world characterized by increased levels of mental involvement with a specific attentional object. Individuals who are high in trait absorption are likely to have intense imaginative responses to sensory events and become deeply immersed in their own internal experiences. The TAS is a 34 item true/false scale. A number of different scoring schemas have been proposed for the TAS (e.g., Roche & McConkey, 1990), however in order to minimise the number of statistical tests performed, we investigated only the TAS total score.

2.3 Procedure

All measures were presented online using the Qualtrics platform. The study consisted of four parts. First, participants answered demographics questions. Second, participants completed the two trait measures, presented in random order: the M5-50 personality questionnaire, and the Tellegen Absorption Scale. Third, participants completed a battery including questions about their media engagement and self representation measures (Flow State Scale, Sense of Agency Rating Scale, ITC-SOPI, Presence Questions, Character Identification Questions and Time Perception Questions) targeting their experience of video games. Fourth, participants completed the same battery of measures targeting their experience movies/TV. These final two blocks were presented in counterbalanced order. The study took approximately 30 minutes.

3. Results

All data and analysis scripts are available on the Open Science Framework at <https://osf.io/pd5fb/>

3.1 Media habits

Participants reported engaging with active media on more days per week ($M = 4.94$, $SD = 1.78$) than passive media ($M = 3.15$, $SD = 2.14$, $t = 9.57$, $p = < 0.001$, $95\% CI = [1.42, 2.16]$). Participants also reported engaging with active media for more hours per week ($M = 18.61$, $SD = 19.23$) than passive media ($M = 10.92$, $SD = 18.00$, $t = 4.35$, $p = < 0.001$, $95\% CI = [4.22, 11.17]$).

Table 1. Social context of active and passive media.

	Alone	With Others	Connect Remotely
Active media	140	41	93
Passive media	145	95	11

Table 1 shows the social context of media engagement. There was a significant association between type of media and social context $\chi^2(2) = 85.34, p < .001$. This represents the fact that individuals were more likely to connect with others in person when watching passive media and more likely to connect with others remotely while playing games (active media).

3.2 Self representation in active and passive media

We used a series of paired t-tests to compare the self representation measures for active and passive media. To minimise error, we used the Holm-Bonferroni correction for multiple (10) comparisons. Adjusted p-values are reported. These results are shown in table 2.

Flow was significantly higher for video games compared to movies/TV ($t = 8.81, p < 0.001, 95\% CI = [0.25, 0.40]$).

Table 2. Flow, agency, presence, character identification, and time perception scores for active and passive media. Holm-Bonferroni adjusted p-values are reported.

	Active	Passive	t	df	p	CI	d
	Mean (sd)	Mean (sd)					

With sense of agency, SOARS Involuntariness was higher for movies/TV compared to video games, reflecting the inherently non-interactive nature of passive media ($t = -6.50, p < 0.001, 95\% CI = [-3.76, -2.01]$). Conversely, there was no difference between SOARS Effortlessness for video games compared to movies/TV ($t = -0.10, p = 1.000$). Rather than directly tapping feelings of control over events, Effortlessness represents a feeling of spontaneous involvement and it appears that this was experienced to a similar degree for both forms of media.

We had two measures of the sense of presence. The ITC-SOPI has several subscales that tap different elements of the experience of presence. Spatial Presence, which represents a sense of physical placement in the media environment, was higher in video games compared

to movies/TV ($t = 9.95, p = 0.001, 95\% CI = [0.45, 0.68]$), indicating that awareness of the virtual environment in which the events portrayed in media take place is more pronounced in active media. Negative Effects, which represents unpleasant feelings associated with media engagement, was also higher in video games compared to movies/TV ($t = 3.23, p = 0.004, 95\% CI = [0.05, 0.20]$). This indicates that active media may be more likely to induce sensations of physical or mental discomfort. Ecological Validity, which represents the realism and believability of media experiences, was higher in movies/TV compared to video games ($t = -4.12, p < 0.001, 95\% CI = [-0.39, 0.14]$). This likely reflects the fact that passive media often involves realistic video whereas active media typically involves digital scenes. Scores on the Engagement subscale, which represents subjective involvement in media, were similar for both media types.

The Presence Questions score, which taps broad feelings of immersion, was higher for video games compared to movies/TV ($t = 7.36, p < 0.001, 95\% CI = [0.55, 0.95]$). This suggests that overall, participants experienced greater presence for active compared to passive media.

Character Identification scores were higher for games compared to movies/TV ($t = 4.61, p < 0.001, 95\% CI = [0.27, 0.68]$), indicating that participants felt closer and more similar to characters in active media.

Time perception scores were significantly higher for active compared to passive media ($t = 9.15, p < 0.001, 95\% CI = [0.48, 0.74]$), indicating that participants were more likely to experience subjective acceleration of time when playing video games compared to when watching movies/TV.

3.3 Associations between self representation measures

We next investigated relationships between the measures of self representation. We calculated mean values for each of our state measures (i.e., flow, agency, presence, character identification, and time perception scores) across both media contexts. Associations across these variables are shown in Table 3. To minimise error, we used the Holm-Bonferroni correction for multiple (45) comparisons. Adjusted p-values are reported.

Flow was associated with sense of agency measures, character identification, and all presence measures, with the exception of the Negative Effects factor of the ITC Presence scale. This suggests that flow is typically a positive experience that is connected to pleasurable aspects of self representation change during media engagement.

Surprisingly, the two agency subscales (Involuntariness and Effortlessness) were negatively related in this dataset ($r = -.53, p < .001$), indicating distinct types of agentive awareness during media engagement. The Involuntariness subscale, representing feelings of reduced volitional control, was associated with negative aspects of presence ($r = 0.30, p < .001$), whereas the Effortlessness subscale, representing feelings of passive automaticity, was associated with a reduction in negative aspects of presence ($r = -0.52, p < .001$). Effortlessness was also associated with higher levels of media engagement ($r = 0.25, p = .004$).

As expected, the presence measures were all highly related. All presence measures were associated with higher levels of character identification (all $p \leq 0.04$), and all presence measures apart from Negative Effects were associated with time distortion (all $p \leq 0.23$).

3.4 Trait and state influences on media experience

Finally, we looked at the influence of individual difference characteristics. We investigated associations between mean values for each state variable (averaged across both media contexts) and scores on each of our trait measures. Correlations between trait and state variables are shown in Table 4. To minimise error, we used the Holm-Bonferroni correction for multiple (60) comparisons. Adjusted p-values are reported.

There was evidence of some relationships between personality traits and particular aspects of self representation during media engagement. Conscientiousness was positively associated with flow ($r = 0.31, p < .001$), and effortlessness ($r = 0.26, p = .006$); and negatively associated involuntariness ($r = -0.24, p = .013$) and negative aspects of presence ($r = -0.27, p = .003$). Neuroticism was negatively associated with experiences of flow ($r = -0.25, p = .007$). Openness was positively associated with Effortlessness ($r = 0.28, p = .001$) and Engagement ($r = 0.23, p = .024$) but negatively associated with Negative Effects ($r = -0.29, p = .001$).

Absorption was positively associated with Flow ($r = .24, p = .012$), Spatial Presence ($r = .51, p < .001$), Engagement ($r = .44, p < .001$), Ecological Validity ($r = .43, p < .001$), overall Presence ($r = .49, p < .001$), and Character Identification ($r = .34, p < .001$).

Table 3: Associations between state measures of self representation (flow; agency; presence; character identification; time perception). Holm-Bonferroni adjusted p-values are reported.

	SOARS Involuntariness	SOARS Effortlessness	ITC Spatial Presence	ITC Engagement	ITC Ecological Validity	ITC Negative Effects	Presence	Character Identification	Time Perception
DFS	-0.33***	0.33***	0.34***	0.38***	0.34***	-0.11	0.37***	0.28***	0.18
SOARS Involuntariness		-0.53***	0.08	-0.09	0.03	0.30***	0.11	0.04	-0.07
SOARS Effortlessness			-0.04	0.25**	0.05	-0.52***	-0.05	-0.02	0.04
ITC Spatial Presence				0.60***	0.87***	0.24**	0.80***	0.60***	0.22*
ITC Engagement					0.6***	-0.02	0.61***	0.38***	0.27**
ITC Ecological Validity						0.12	0.71***	0.53***	0.22*
ITC Negative Effects							0.21*	0.21*	-0.03
Presence								0.57***	0.25**
Character Identification									0.11

*** p < .001, ** p < .01, * p < .05

Table 4: Associations between trait measures (Tellegen Absorption Scale; M5-50 Personality) and state measures (flow; agency; presence; character identification; time perception). Holm-Bonferroni adjusted p-values are reported.

Trait Measure	DFS	SOARS		ITC		ITC	ITC	Presence	Character Identification	Time Perception
		Involuntariness	Effortlessness	Spatial Presence	ITC Engagement	Ecological Validity	Negative Effects			
M5-50 Personality Scale										
Extraversion	0.17	-0.09	-0.01	0.06	-0.07	0.06	0.00	0.05	-0.02	0.06
Agreeableness	0.06	-0.02	0.06	0.11	0.07	0.10	-0.17	0.04	0.04	0.12
Conscientiousness	0.31***	-0.24*	0.26**	0.10	-0.05	0.12	-0.27**	0.06	0.10	0.07
Neuroticism	-0.25**	0.15	-0.10	-0.06	0.16	-0.07	0.17	-0.02	-0.07	-0.08
Openness	0.06	-0.17	0.28**	-0.02	0.23*	0.01	-0.29***	-0.01	-0.10	-0.05
Tellegen Absorption Scale										
Total Absorption Score	0.24*	0.03	0.02	0.51***	0.44***	0.43***	0.07	0.49***	0.34***	0.10

*** p < .001, ** p < .01, * p < .05

4. Discussion

This study explored how different kinds of media impacted the ways that individuals experienced and represented aspects of bodily self consciousness. We expected that active media (i.e., computer games) would be experienced quite differently from passive media (i.e, movies and television). In terms of exposure, we found that participants viewed active media on more days and for more hours during each viewing, compared to passive media. We also found significant differences between active and passive media across most dimensions of self representation.

Participants reported increased levels of flow for active media compared to passive media. This is consistent with previous work that has shown that video games are associated with flow experiences (Kaye, 2016; Sherry, 2004). Notably, although flow was significantly lower for passive media, the difference in mean ratings between conditions was not pronounced (mean difference: 0.32 on a 7-point scale). This suggests that individuals also did experience some degree of flow when engaging with movies and television.

Findings related to sense of agency were mixed. Participants reported significantly higher levels of involuntariness for passive compared to active media. This is consistent with participants having less objective control over passive media (i.e., participants' decisions do not have a causal influence on passive media, whereas they can influence active media). However, we found no difference in reported levels of effortless for active and passive media. This finding is surprising as there appear to be objective difference in the level of physical activity between these media types. When consuming passive media participants are not required to make any body movements, whereas active media depends on some form of physical interaction with a human-computer interface device. The null finding here may reflect similar levels of mental engagement across media

types. That is, it may be that participants use similar levels of mental effort to follow and interpret the plot of movies/television as they do when planning responses in video games. Sense of agency measurement tools that explicitly distinguish between physical and mental effort would be needed to test this interpretation. This is something our lab is working on.

Findings related to presence were similarly nuanced. The Presence Scale, which gives an overall indication of immersion, indicated greater presence experience in active compared to passive media. The ITC-SOPI scale however, which measures multiple dimensions of the experience of presence, showed that active media involved higher levels of Spatial Presence and also higher levels of Negative Effects than passive media. Passive media, by contrast, higher levels of Ecological Validity. These findings indicate that although video games are more able to activate many multisensory cues relevant for self representation, passive media still tends to be experienced as more real, despite typically being viewed on less sophisticated technology.

As expected, active media did involve significantly greater character involvement than passive media. Consistent with Klimmt, Hefner and Vorderer (2009), this suggests that character involvement is specifically enhanced by exerting a causal influence on a character's actions (as occurs in active media), and less connected to realism or narrative.

Active media did lead participants to experience significantly greater time distortion than passive media. Specifically, participants reported that time passed more quickly when engaged with video games compared to movies / television. Previous research has shown time perception changes associated with video game play (e.g., Rau et al., 2006; Tobin & Grondin, 2009; Wood, Griffiths, & Parke, 2007), but time perception in

passive media is relatively understudied (although see Kweon, Hwang, & Jo, 2011). The current results suggest that time perception changes require active involvement with media and that such perceptual distortion may occur regardless of other alterations in self representation.

We identified a revealing set of relationships between different measures of self representation. First, we found that flow, presence and character identification were all closely inter-related, suggesting that these variables may describe a common core phenomenology of self representation change associated with media engagement. Similarly, time perception was related to most presence measures but not to other aspects of self representation, suggesting that increased feelings of presence specifically lead to changes in the way that time is monitored. The role of sense of agency in media engagement was more complex. Agency did not change in a uniform way along with the other variables measured. Instead, the two components of agency measured by the SOARS scale were connected to different aspects of self representation. Involuntariness, which is more about direct feelings of reduced control in a given situation (Polito et al., 2015), was associated with lower levels of flow and with negative or unpleasant aspects of presence. Effortlessness, by contrast, has been linked to higher-order monitoring of actions and feelings of surprise and spontaneity (Pritchard et al., 2016). Here, we found that Effortlessness was associated with greater levels of engagement and reduced negative effects. Together these findings support a multidimensional and dynamic conceptualisation of the sense of agency (Polito, Barnier, Woody, & Connors, 2014).

We found evidence for personality related differences in media experience. Results indicated that conscientious individuals were more likely to have experience of passive ease during media engagement and less likely to have unpleasant sensations or a sense of losing control; that neurotic individuals were less likely to become engaged and involved with media; and that individuals higher in trait openness were more likely to report

easy and intense engagement with media. Together, these findings suggest that individuals who are more attentive and accepting of new ideas are likely to have more involved and pleasant media experiences. We did not find support for previously identified relationships between extraversion and presence (Alsina-Jurnet & Gutiérrez-Maldonado, 2010), agreeableness and presence (McCreery et al., 2012), or openness and character identification (Soutter & Hitchens, 2016).

We did find that trait absorption was strongly associated with experience of flow, presence and character identification. This is consistent with earlier findings linking more immersive media experiences with absorption (Baños et al., 1999; Kober & Neuper, 2013) and also with work showing that absorption predicts general alterations in self consciousness (Mohr, 2018).

4.1 Limitations and Future Directions

There were a number of limitations to this study. We aimed at a broad investigation of naturalistic media experiences. As such, participants reported on their engagement with a wide variety of media content. Here we only distinguished between active and passive media types. An important direction for future research is to investigate potential differences in self representation related to specific media content (for example, by targeting specific genres). A further limitation is the generalisability of these findings. Because we aimed at comparing active and passive media experiences we necessarily recruited participants who regularly spend considerable amounts of time both playing video games and watching movies / television. The media experiences of these individuals may not reflect the experiences of people with different profiles of media engagement.

4.2 Conclusions

Overall the current findings indicate that active media leads to more pronounced alterations in most aspects of self representation compared to passive media, but that the difference between media types is not as clear cut as might be expected. Specifically, we found evidence of greater levels of flow, agentive involuntariness, some aspects of presence, and time perception for active compared to passive media. We found no significant differences in agentive effort, engagement, ecological validity or character identification. We also found little evidence of personality based differences in media experience, suggesting that, in general, self representation is more dependent on properties of the media stimulus than on the individual. This suggests that media targeted to traditional personality types is unlikely to lead to noticeably different forms of self experience for media consumers. There were however marked differences in most aspects self representation related to individual differences in absorption. Researchers and media creators wanting to create content that leads to changes in self representation may find it useful to target high absorption individuals.

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